REMARKS

This paper responds to the Office Action mailed on November 4, 2005.

No claims are amended, no claims are canceled, and no claims are added; as a result, claims 1, 2, 5-10, 13-15, 18-23, 26-31, 34–37, 51, 52, 54-56, and 62 are now pending in this application.

§103 Rejection of the Claims

Claims 1-2, 4-6, 14-15, 17-20, 51-52, 55-56 and 62 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Ma (U.S. 6,207,589) in view of Park (U.S. 5,795,808) and further in view of Yano (U.S. 5,810,923). Applicant respectfully traverses this rejection.

Ma discloses a metal oxide gate dielectric formed of either Zr or Hf alloyed with approximately 25% of a trivalent metal such as aluminum or lanthanum, formed by either sputtering in an oxygen ambient, cosputtering in an oxygen ambient, chemical vapor deposition in an oxygen ambient, or evaporation and annealing in an oxygen ambient. The final structure has an interface barrier 62 having a thickness 64 of typically 2-5 angstroms. The interface barrier 62 is formed of either silicon nitride or silicon oxynitride (see col. 2, line 17 and col. 6, line 9 and figures 12 and 13). The Examiner admits in section 2 on page 2 that Ma does not teach the use of electron beam evaporation, or a smooth surface, but states on page 3 that sputtering, chemical vapor deposition and evaporation deposition "have an art recognized equivalence". Applicant respectfully disagrees with the Examiner as to the equivalence of the three methods of deposition, and respectfully disagrees that there is any suggestion to one of ordinary skill in the art to use a pure metal rather than the trivalent metal doped film of Ma.

Park is used to show that sputtering and evaporation are art recognized equivalents. Yano is used to show that the deposition temperature range, the use of atomic oxygen, and that smooth metal oxide surfaces are known..

Applicant respectfully disagrees with the Examiner that Ma teaches a pure metal. The cited section (col. 5, line 66) of the Ma reference states that the "percentage of Al, or other trivalent metal, in film 56 is in the range of approximately 0-50%. Preferably, the percentage of Al in film 56 is approximately 25%". The cited reference of Ma teaches the use of trivalent

metal doping for the gate oxide throughout the specification, for example in the title, abstract, figures 1, 2, 5-10; col. 1, lines 62-67; col. 2 lines 22, 26, 37, 49, 60 and 67; col. 3, lines 44, 60, 64; col. 4, lines 3, 14, 28, 46, 52, col. 5, lines 44, 52, 61; and so on throughout the specification. Therefore, Applicant respectfully disagrees with the Examiner's statement in paragraph 7 on page 13 of the Office Action that the Ma reference does teach pure metal, since clearly Ma discusses repeatedly the use of doped metal.

The Examiner must provide objective teaching from the cited reference showing motivation to make the change from repeated discussion of alloy metal to pure metal. The Examiner has the burden under 35 USC § 103 to establish a *prima facie* case of obviousness. In combining prior art references to construct a *prima facie* case, the Examiner must show some objective teaching in the prior art or some knowledge generally available to one of ordinary skill in the art that would lead an individual to combine the relevant teaching of the references. *In re Fine*, 837 F.2d 1071, 1074, 5 U.S.P.Q.2d (BNA) 1596, 1598 (Fed. Cir. 1988). Neither Ma nor Yano give any reason why the use of a substantially pure metal would be a benefit, as opposed to their clear teaching of the use of heavy alloyed metal.

Ma also teaches that the insulator layer includes an interface barrier 62 of silicon nitride or silicon oxy-nitride (see col. 2, line 13 and col. 6, line 10). Clearly, Ma does not suggest the use of a single element metal layer, since even if there were motivation to use a substantially pure metal, the presence of an initial dielectric under the metal oxide would teach away from the claimed arrangement..

For at least the above reason, Applicant respectfully submits that one of ordinary skill in the art could not read the suggested combination of Ma with Park and Yano as describing or suggesting at least the claimed feature of a "... *substantially single element metal layer directly contacting the body region* ...", as recited in independent claims 1, 9, 14, 22, 30, 51, 55 and 62. None of the cited references suggests at least this feature to one of ordinary skill in the art. Furthermore, Ma teaches that the metal oxide layer is formed on a silicon nitride layer and thus fails to describe or suggest at least the claimed feature of "...*directly contacting the body region* ...", as recited in the independent claims. Thus the cited references do not suggest either a single element layer, or that the layer is directly contacting the body region.

Applicant herein repeats the previous discussion in prior responses that sputtering and evaporation are not equivalent operations. The present specification, as noted in figure 2b and 2c, and discussed at least at page 3, line 10 to line 24, discloses that sputtering causes physical and radiation damage to the substrate surface that cannot be repaired by annealing, resulting in rough surfaces. One of ordinary skill in the art would understand that low leakage current cannot be obtained by sputtering on the bare channel regions of a MOSFET, and the use of sputtering would result in an inoperative device. Thus, Ma's use of sputtering metal causes rough surfaces that can not be corrected, and the Ma reference teaches against the current arrangement.

The Ma reference teaches the insulator layer is to remain amorphous (see abstract, col. 1, line 53; col. 3, line 62). The Yano reference teaches the importance of the insulator film being crystalline (see co. 1, lines 29-53; col. 2, lines 1, 23, 28, 35, 50, 59; col. 3, lines 15, 24; col. 4, lines 1, 8, 41; and throughout the specification). Thus, Applicant respectfully submits that there is no objective reason stated for combining the two references, and the combination is improper.

For the above noted reasons, Applicant submits that the suggested combination of reference is inappropriate and uses forbidden hindsight, and even if there were motivation to make the combination, the results would still be different, at least in evaporating a substantially pure metal on the body region of the transistor. The dependent claims are believed patentable at least as depending from patentable base claims, as discussed above, and as presenting further patentable features, such as the use of mixed plasma oxidation. In view of the above argument, Applicant respectfully requests that this rejection be reconsidered and withdrawn.

Claims 8, 21, and 54 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Ma in view of Park and Yano, and further in view of Moise (U.S. 6,211,035). Applicant respectfully traverses this rejection.

Ma, Park and Yano have features that have been discussed above. Moise is used in the outstanding Office Action to show that oxidizing in a krypton and oxygen mixed plasma is known.

Applicant respectfully submits that the addition of the Moise reference to the suggested combination of Ma and Park does nothing to cure the above-noted deficiencies in the combination of Ma, Park and Yano with regard to independent claims 1, 14 and 51, from which

the claims in question depend. In particular, the suggested combination does not suggest the direct contact to the channel region, or the use of a substantially pure metal, or the substantial amorphousness of the deposited metal.

Applicant respectfully requests that this rejection be reconsidered and withdrawn.

Claims 9-10 and 12-13 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Ma in view of Park and Yano, and further in view of Moise. Applicant respectfully traverses this rejection.

The references have all been discussed above, and it is submitted that the suggested combination fails to describe or suggest "*...evaporation depositing a substantially amorphous and substantially single element metal layer directly contacting the body region using electron beam evaporation, the metal being chosen from the group IVB elements of the periodic table; and oxidizing the metal layer using a krypton(Kr)/oxygen (O_2) mixed plasma process to form a metal oxide layer directly contacting the body region...*", as recited in claim 9. This is true for many of the same reasons given above with reference to the prior rejections, and further because of the oxidation of the metal using a mixed Kr/O plasma. Ma discloses an interface barrier, the use of sputtering an alloyed, non-pure metal, as discussed above, and the addition of the Moise reference are not seen as providing any teaching to cure the deficiencies of Ma and the other references. Therefore, independent claim 9 is believed patentable over the suggested combination of references.

The dependent claims are believed patentable at least as depending from claims shown above to be patentable. Applicant respectfully requests that this rejection be reconsidered and withdrawn.

Claims 22-23, 25-28, 30-31 and 33-36 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Ma in view of Park and Yano, and further in view of Maiti (U.S. 6,020,024) and the admitted prior art (APA). Applicant respectfully traverses this rejection.

Ma, Park and Yano have been discussed above. The cited Maiti reference discloses a high dielectric constant metal oxide layer on a silicon nitride layer grown on the body region of a semiconductor device. Maiti's silicon nitride layer 14 is intentionally formed by ion

implantation of nitrogen, thermal nitridation of an oxide layer by ammonia, nitric oxide, nitrous oxide, or plasma/thermal processing (see col. 3, lines 24-26). Maiti is used in the outstanding Office Action to show that it is known to use high k metal oxides for transistors. The APA is used to show that processor chips are known.

The suggested combination fails to describe or suggest at least the claimed feature of "*...evaporation depositing a substantially amorphous and substantially single element metal layer directly contacting the body region using electron beam evaporation, the metal being chosen from the group IVB elements of the periodic table; oxidizing the metal layer to form a metal oxide layer directly contacting the body region ...*", as recited in claims 22 and 30.

As discussed previously the suggested combination of references does not suggest direct deposition of a substantially pure metal on the channel region, or the oxidation of the metal, and thus can not suggest to one of ordinary skill at least the above noted features of the claimed invention.

The dependent claims are held to be in patentable condition at least as depending from claims shown above to be patentable. Applicant respectfully requests that this rejection be reconsidered and withdrawn.

Claims 29 and 37 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Ma in view of Park and Yano, and further in view Maiti and the admitted prior art, and further in view of Moise. Applicant respectfully traverses this rejection.

The cited references have all been discussed above. Applicant respectfully submits that independent claims 22 and 30, from which claims 29 and 37 respectively depend, are patentable over at least because the suggested combination of references fails to describe or suggest at least the claimed feature of "*...evaporation depositing a substantially amorphous and substantially single element metal layer directly contacting the body region using electron beam evaporation, the metal being chosen from the group IVB elements of the periodic table; oxidizing the metal layer to form a metal oxide layer directly contacting the body region, wherein the metal oxide layer has a smooth surface with a surface roughness variation of 0.6 nm...*", as recited in claims 22 and 30, as amended herein.

Applicant respectfully disagrees with the statement in the outstanding Office Action on page 12, second paragraph that "Moise teaches oxidizing a metal layer with inert gases such as argon or krypton (column 12 lines 23-24)", since it is chemically not possible to oxidize in the inert ambients since the indicated portion of Moise is discussing plasma etching. One of ordinary skill in the art would not look to a method of completely removing an oxide layer (i.e., etching) when looking to obtain a metal oxidation process, such as the claimed invention.

The dependent claims are held to be in patentable condition at least as depending from claims shown above to be patentable. Applicant respectfully requests that this rejection be reconsidered and withdrawn.

CONCLUSION

Applicant respectfully submits that the claims are in condition for allowance and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's attorney David Suhl at 508-865-8211, or the below-signed attorney at (612) 373-6900, to facilitate prosecution of this application.

If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully submitted,

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Date 6 Feb '06

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CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail, in an envelope addressed to: Mail Stop RCE, Commissioner of Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on this 6 day of February, 2006.

LISA POSORSKE
Name

Signature